

§27. Analysis for Plasma Wall Interactions in LHD

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In LHD, the co-deposited carbon film is produced at the wall of pumping duct during the local island divertor (LID) experiments. A divertor head made of carbon fiber composite is employed. Four sets of material probes made of Si were installed in the vicinity of the LID head in the 9th and 10th campaigns. One set of probes was placed inside the pumping duct (1U, 1L), and faced to the head. The other set of probes has a shallow line of sight to the head (2U, 2L). After the campaign, the probes were extracted and their surface behavior was investigated [1].

The crystal structure of 1U and 1L showed a typical amorphous structure consisting of graphite and defective graphite peaks. However, the structure of 2U and 2L was a typical polymer structure. The thickness of carbon films was measured by using a surface roughness meter, and it was in the range from 200 to 700 nm. In the thermal desorption spectra of the four probes, most of retained hydrogen desorbed in form of hydrogen molecular. The desorption spectra of 1U and 1L have a peak around 1000 K and 1050 K, respectively. This tendency is similar to that of graphite. However, the spectra of 2U and 2L were very different from that of 1U and 1L. A desorption peak was observed at lower temperature regime, around 950 K. This different behavior is caused by the polymer structure of carbon films on 2U and 2L. The mass densities of carbon films on the four probes are in the range from 0.90 to 0.93 g/cm³. The hydrogen concentrations of

carbon films at 1U and 1L became H/C = 0.55 and at 2L and 2U H/C = 1.25. The temperature at 2U and 2L was 300 K, and the temperature at 1U and 1L was 600 K. The deuterium concentration in graphite after deuterium ion irradiation has been well investigated so far. It is well known that the deuterium concentrations in graphite at 300 K and 600 K are D/C = 0.4 and 0.2, respectively [2,3]. Figure 1 shows the hydrogen concentrations of the present co-deposited carbon films, which are compared with the deuterium concentration in graphite after deuterium ion irradiation.

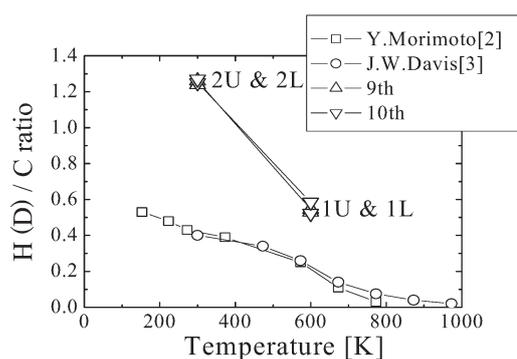


Fig. 1 Hydrogen concentration of co-deposited carbon films (upper) and deuterium concentration in graphite (bottom) versus wall temperature.

The co-deposited carbon films produced at the wall with a relatively low temperature showed an extremely high hydrogen concentration, 2 - 3 times higher than the existing value. Such the high concentration was firstly observed. In ITER, the machine operation is limited by the amount of in-vessel tritium inventory. The present result is very useful to evaluate the in-vessel tritium inventory.

[1] T. Hino et al, To be presented in 22nd IAEA Conf. (2008)

[2] Y. Morimoto et al., J. Nucl. Mater. **313-316**, 595 (2003)

[3] J.W. Davis et al, J. Nucl. Mater. **217**, 206 (1994).